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Re-programming the Mind through Logic. The Social Role of Logic in Positivism and Lieber's *Mits, Wits and Logic*

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ABSTRACT: This essay on the social history of logic instruction considers the programmatic writings of Carnap/Neurath, but especially the widely read book by Lillian Lieber, *Mits, Wits and Logic* (1947), where Mits is the man in the street and Wits the woman in the street. In the 'pre-Toulmin' days it was seriously argued that the intense study of formal logic would create a more rational frame of mind and have many beneficial effects upon social and political life. It arose from the conviction that most metaphysical conundrums, religious and political problems and even fanaticism had their root in the irrationality of ordinary discourse, which had to be replaced by the more logical 'ideal language' of *Principia Mathematica*. The enthusiastic promotion of formal logic occurred at a time when it was widely thought that minds could be 'made over', 'reprogrammed' by proper intervention. This stands in stark contrast to the motivation for teaching *informal* logic and critical thinking, as becomes apparent in a 1981 exchange between Ralph Johnson and Gerald Massey in *Teaching Philosophy*. Most of this essay focuses on Lillian Lieber, an earnest and enthusiastic advocate of the cause of formal logic, and on the reasons for the widespread conviction that, for the sake of peace and social harmony, formal logic should, if possible, be taught to every man, woman and child.

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KEY WORDS: ideal language, programming, Lieber, Ralph Johnson, Gerald Massey, social importance of logic

1. INTRODUCTION

These days courses in formal logic attract far fewer students than they once did. The question we raise is not why there are so few participants now, but why there ever were so many. Not long ago it was widely thought imperative, not just desirable, that every college and university student should have at least some knowledge of formal logic. The reason sometimes given was that this pursuit has broad and good effects upon the mind: discipline of thought, awareness of connections, etc., benefits that a couple of generations earlier were attributed to the study of Latin, which was taught everywhere, but rarely to the point of actual comprehension. We offer here some reflections on the social role assigned to logic instruction in the 'pre – Toulmin' days.

A.N. Whitehead once remarked that 'operations of thought are like cavalry charges; they must be carefully planned and they require fresh horses' (Belnap, [p. 420](#)). Gilbert Ryle carried forward the military analogy, and claimed that training in formal logic is much like a parade-ground drill:

It is not the stereotyped motions of drill, but its standards of perfection of control which are transmitted from the parade-ground to the battlefield ... To know how to go through completely stereotyped

movements in artificial parade-ground conditions with perfect correctness [though 'unmitigated tedium'] is to have learned not indeed how to conduct oneself in battle, but how rigorously to apply standards of soldierly efficiency even to unrehearsed actions and decisions in novel and nasty situations and in irregular and unfamiliar country. (Ryle, pp. 112, 123)

Kenneth Keyes admonishes: 'You will be wasting your time if you don't do your best to work these thinking habits deeply into your nervous system' (p. 35).

Toulmin argues that treating logic as an analysis of the nature of *thought* will either turn it into a technology where 'a textbook of logic becomes as it were a craft manual' or else into a branch of psychology (p. 4). But Ryle's is an inverse psychologism: logic does not *record* the mind's actions, but disciplines them. He does not suggest the 'primitive' psychologism (cf. Toulmin, pp. 84-88) that takes logic to be to the mind what anatomy is to the body (as it has sometimes been put). He is arguing, rather, that the diligent study of formal logic will sufficiently restructure the mind to prepare it for life's and philosophy's struggles. It is more like massage therapy than anatomy. He notes that

With a negligible number of exceptions, every philosopher of genius and nearly every philosopher of even high talent...has given himself some schooling in some parts of Formal Logic, and his subsequent philosophical reasonings have exhibited the effects upon him of this..., including sometimes his revolts against it. (Ryle, p. 112)

There is some empirical evidence for this. Inspecting their vitae, I have concluded that Johnson, Blair, Hansen, Govier, Groarke, Tindale, Gilbert and other front horses of the informal logic movement have all been drilled on the parade ground of formal logic - in some cases I was an eye witness. If Ryle is right, this explains their success. They will of course deny this, but denial is a standard strategy of self defence.

2. MASSEY VS. JOHNSON

1981 is an interesting year in the dispute between informal logicians and the formal lot. In that year Nuel Belnap published an article in *Teaching Philosophy* where he quotes an example from Copi's logic text (the 1972 edition):

If the airplane had engine trouble, it would have landed at Bridgeport. If the airplane did not have engine trouble, it landed at Cleveland. The airplane did not land at either Bridgeport or Cleveland. Therefore it landed in Denver.

Belnap, as he should be, is shocked by the claim that this absurdity is a *valid* argument. How did *Denver* get into the picture? He says that Copi 'tries to de-shock us by pointing out that the premises are inconsistent, and that 'any argument with inconsistent premises is valid, regardless of what its conclusion may be'' (Belnap, p. 424). This is, however, an intramural scrap among formalists. Anderson and Belnap's brilliant contribution to the logic of relevance notwithstanding, they show little sympathy for the objectives of informal logic. In that same year, and in the same journal, Gerald Massey argued

Logic inculcates portable skills and strategies that students can bring to bear on all their other subjects at great profit. The result is a degree of intellectual sophistication otherwise unattainable (304)...[whereas] informal logic amounts to little more than unpremeditated importation of sloppiness, confusion and obscurity into a subject (logic) where rigor, clarity, and precision ought to reign supreme. (Massey, p. 305)

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Plainly, this was aimed at Ralph Johnson who had earlier maintained in the same journal that

The goal of an informal logic course is to equip the students with the skills needed to make a coherent assessment of the logical merits and demerits of real arguments, and the capacity to transform that assessment into an intelligent piece of logical criticism...There is no real profit to be derived from analyzing those invented and docile creatures which, until very recently, populated logic texts. (Johnson, p. 124)

Everyone remembers the docile creatures like 'Write in symbolic notation 'No unicorns eat oats' and 'Some blondes have blue eyes'' (Brennan, pp. 29, 36). The informal logic texts, on the other hand, do not focus on parade ground drill, on the re-programming of mind through exposure to formalism, but charge directly into manoeuvres, simulations of battle that are close to the real thing, and discuss and analyse issues of present and important concern. Quickly a couple of examples, though mentioning them to this audience is like carrying coals to Newcastle or, as the Germans say, carrying owls to Athens.

As usual, Canadians, who are incompetent, inefficient, lazy, miserable, and jealous, cannot compete with the USA... Consequently, they always want U.S. products and performers banned so they can produce the usually poor product (Johnson and Blair p. 131, quoting from the Edmonton Journal). Crawford Kilian equates the specificity of recruiting a black person as head of the Johnston Chair for Black Studies at Dalhousie University to establishing segregated public toilets for blacks... (Groarke, Tindale, and Fisher, p. 282, quoting a letter to the Globe and Mail.)

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So then, analyze this and contrast it with the docile 'The owl of Minerva flies at night. *Therefore* Minerva has exactly one owl'.

3. THE IDEAL LANGUAGE

There was a time when in much of the philosophical scene 'classical' logic, i.e. the logic of *Principia Mathematica*, (which is two-valued, with excluded middle, non-empty domain), enjoyed a monopoly position. Some, e.g. Gustav Bergmann, deemed it to be the 'Ideal Language'. This was meant to imply that whatever cannot be expressed in its formalism is nonsensical.¹ That ideal was still much argued in the 1950s, but had its proper home some years before in the Vienna Circle, Reichenbach's school in Berlin and the Warsaw logicians. It arose from the conviction that most metaphysical conundrums, religious and political problems and even fanaticism had their root in the irrationality of ordinary discourse.

In a programmatic statement of August 1929 Neurath (with Hahn and Carnap), made much of the '*logical origins of metaphysical aberration*', and the 'too narrow tie to the form of *traditional languages*' (Neurath 1973, p. 9, their italics). These metaphysical aberrations were never taken as harmless: they lead not just to a distortion of thought, but of life. The pamphlet ends with these words:

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¹ Historians of logic sometimes savaged earlier systems of logic by treating them as anticipatory gropings to discover the one true logic. The treatment of Bolzano in Bar-Hillel (1952) and some other commentators is of this sort. Like many others he was imbued with missionary certitude that *Principia Mathematica* was the ideal language, and that earlier logics were either way stations on the path to that summit, or else had no standing in the history of logic. Bar-Hillel's reconstruction summarizes Bolzano's theory of consequence in 22 propositions, eight of which are anti-theorems or not provable in Bolzano, while three of Bolzano's theorems (WL § 155 No 4, 7, 21) are anti-theorems or just nonsense in Bar-Hillel's reconstruction.

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The scientific world-conception is close to the life of the present. Certainly it is threatened with hard struggles and hostility. Nevertheless there are many who do not despair but, in view of the present social situation, look forward with hope to the course of events to come. Of course not every adherent of the scientific world conception will be a fighter. Some, seeking solitude, will lead a withdrawn existence on the icy slopes of logic; some may even disdain mingling with the masses and regret the 'trivialized' form that these matters inevitably take on spreading. However, their achievements too will take a place among the historic developments. We witness the spirit of the scientific world-conception penetrating in growing measure the forms of personal and public life, in education, upbringing, architecture, and the shaping of economic and social life according to rational principles. *The scientific world conception serves life, and life receives it.* (pp. 19 f.)

Carnap expressed similar sentiments in *Der logische Aufbau der Welt* of 1928, with a somewhat darker, and as it turned out more realistic, assessment of trends in the 'philosophic-metaphysical and religious domain that opposes the [scientific] stance'. He noted that they had become 'much stronger' (Carnap, 1961, p. XX). Not much later disaster struck. Grelling, Dubislav, Lindenbaum and some others paid with their life, the rest fled the continent of Europe.² But they continued their struggle for the scientific worldview, which in many cases took the form of writing text books in symbolic logic. In 1946 Tarski said this about his task:

I have no illusions that the development of logical thought...will have a very essential effect upon the process of the normalisation of human relationships; but I do believe that the wider diffusion of the knowledge of logic may contribute positively to the acceleration of this process. (Tarski, p. XV)

He goes on to say that by making concepts precise and uniform in its own field it sets an example for other domains and thus contributes to better understanding 'between those who have the will to do so'. Moreover,

By perfecting and sharpening the tools of thought, it makes men more critical - and thus makes less likely their being misled by all the pseudo-reasonings to which they are in various parts of the world incessantly exposed today. (ibid.)

We also hear that on one of their walks, Bertrand Russell startled Lady Ottoline by announcing that he found it difficult to talk to ordinary mortals, 'for the language they use is so inaccurate that to me it seems absurd' (Monk, p. 436).

In 1981, the time of the Johnson-Massey dispute, formal logic had become a new game. The Age of Aquarius had dawned not only in Haight Ashbury: formal Logicians, too, had begun to do *their own thing*, devising deviant logics and destroying the unifying belief in the one ideal language. Many-valued logic had been around for some time; intuitionist logic had been introduced; now there was relevance logic, modal logic, free logic and a garden of other varieties.

² Not many logicians of note remained in Germany, and logic, or 'logistics' as they called it, came to be tarred with the same brush as Relativity Theory, which was 'jewish physics': 'The so-called Vienna Circle, a collection of people largely of foreign race, for the most part of near-eastern and oriental race, has proclaimed a new logic that is totally distinct from Arian logic. This 'Vienna Circle' to which Einstein was allied, claims that for them there is no logic, that the primary thing is formalistic, calculating thought, logic secondary. One can sense the Near Easterner who calculates and calculates until reality disappears' (Tirald, 1936, p. 51). The development, and even acceptance, of formal logic was set back in Germany not only by the emigration of its practitioners and these scurrilous attacks, but as well by the almost universal opposition of the academic establishment. At most universities this lasted for a couple of decades after WW 2.

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The period of classical logic's monopoly and trust invested in its salutary power and social value coincided with another ideology, rooted in the belief that human minds can be reprogrammed, made over -- brainwashed if you will. It follows that formal logic should be taught early in life, widely and intensively. (Patrick Suppes then published a book *Set theory for Kindergarten*.) The belief in the malleability and perfectibility of mind has a long tradition. Hartley writes in his *Observations on Man* of 1749:

If beings of the same nature, but whose affections and passions are, at present, in different proportions to each other, be exposed for an indefinite time to the same impressions and associations, all their particular differences will, at last, be overruled, and they will become perfectly similar, or even equal. They may also be made perfectly similar in a finite time, by a proper adjustment of the impressions and associations. (Hartley 84 f. : Passmore, p. 166)

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J.B. Watson (the man who taught the American woman to smoke) wrote:

Some day we shall have hospitals devoted to helping us change our personality, because we can change the personality as easily as we can change the shape of our nose... I wish I could picture for you what a rich and wonderful individual we should make of every healthy child. (Watson, p. 302, Passmore, p. 167)

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The theory was applied with obscene persistence in Ewen Cameron's clinic at McGill University, where he destroyed minds with massive electro shocks, but then could not re-program them. We should also note the confident conviction of Neurath and others that they were an *avant-garde*, ahead of the times, with the common folk to follow in due course. I give an example from the world of Music. Anton Webern (who died in 1945) thought that there would come a time when the post-man on his rounds will whistle his tunes. He was wrong.

4. MITS, WITS, AND LOGIC

The ideological, indeed political component to the promotion of formal logic together with the just mentioned factors is nowhere more eloquently expressed than in Lillian Lieber's *Mits, Wits and Logic* (Lieber, 1960). Mits is the famous man in the street, Wits the woman in the street, and a third character is SAM: science, arts and mathematics. Rudolf Carnap endorsed the book:

Not only did I find 'Mits, Wits and Logic' exceedingly well done...but I was highly gratified to find there the impressive connection of the scientific material with your Weltanschauung, and I am delighted that you too are so deeply impressed with the necessity of avoiding another war...(Lieber, p.7)

The author gratefully acknowledged as well Ernest Nagel's 'enthusiastic expression of approval' (p. 11). The message of the book was not merely that logic should be taught in order to sharpen the mind, to make students more cautious reasoners, more aware of fallacy and deception. Logic, specifically formal logic and Boolean algebra, was thought to play a key role in the rational reconstruction of the individual mind and indeed of the social fabric, and at the very least to satisfy the role that Ryle had assigned to formal logic. I reproduce here excerpts from the text as it was printed. Lieber comments:

This is not intended to be	facilitates rapid reading
free verse.	and everyone
Writing each phrase	is in a hurry
on a separate line	nowadays

Lieber first considers why trust should be put in SAM, since scientists, though they have done some wonderful things, are not better than the rest of us (perhaps good on Sundays but pirates on all the other days of the week) (p. 17 f.).

But SAM himself is DIFFERENT for he is the ESSENCE of what is best in Science, Art, Mathematics,	and therefore is good and true and beautiful on all the days of the week and is always available to guide and help us if we would but go to him But "HOW?" (p. 18 f.)
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SAM's most important teaching is that we should not share the FEELING of confidence of the 'uneducated man out in his own back yard' in the REALITY of what he sees (p. 41). We should rather embrace a theory only 'if it explains more observations more adequately' (p. 42), like heliocentric, rather than geocentric, astronomy. This is not really a stressful thing since

It is the nature of our minds that when we get used to an idea we accept it	quite cheerfully; it becomes the NEW REALISM. (p. 42)
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The people who accept this modern realism are familiar with the process of ongoing sophistication. They are 'PREPARED FOR CHANGE and more willing and able to make NECESSARY ADJUSTMENTS' (p. 44).

SAM knows that such adaptation is entirely possible for human beings, and therefore for YOU. And that all you need for this is more EDUCATION of a kind that will bring you UP TO DATE on	Science, Art, Mathematics, and then your own wonderful possession, your human brain will accept this NEW REALISM which will help you, too, to live in this MODERN WORLD. (p. 45)
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This new realism requires that we should become familiar with the abstract, since the best descriptions of reality are found in the equations of scientists. Specifically 'a good way to describe a 'real' thing is that which remains INVARIANT from different viewpoints' (p. 58). The book then discusses, with quite sophisticated examples, invariance under translation of axes, under rotation etc. Two observers, K and K', can agree on many things by focusing on INVARIANTS. They then have 'some common ground where they can do business together! Is there not a moral here for human relations?' (p. 60). We may speculate that the comprehensive repatterning of the mind resulting from the study of formal logic was thought to have wholesome social consequences because, as noted, the orthodox *Principia* logic did not even allow the formulation of first person expressions. One cannot even say in this formalism, and soon one would be unable even to *think* 'I love you', but only 'Otto loves Alma'.

The education Lieber envisaged would obviously take a long time. Meanwhile, we need an ‘emergency program’, which calls for an international police force, disarmament of all nations and so forth (p. 50). Those who think war inevitable and other obscurantists and fear mongers, the ANTI-SAM-ITES, must be defeated by reason; there is a race on between education and catastrophe. Such training and effort are ESSENTIAL in a DEMOCRACY (p. 138). After lengthy preliminaries that justify the enterprise, Lieber finally gets down to actual logic instruction. Chapter XX, on Boolean algebra, begins thus:

Are you learning
how to follow
SAM’s advice?
This is your best
INSURANCE.
against CATASTROPHE.
If you realize that

ONE WORLD
has now become
IMPERATIVE
then you may wish to read more about
LOGIC,
for you will need it
if you are here ‘to tell the tale’. (p. 182 f.)

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Logic is needed, and if we get into it with SAM at our side to LEAD us, we shall tackle our problems in his spirit of

FAITH,
HOPE,
CHARITY,
JUSTICE,
MERCY,
HUMILITY,
INTELLIGENCE,

IMAGINATION,
MODERN REALIS M
MODERN ABSTRACT TOOLS
in short,
with the essence of
what is best in
human nature. (p. 234)

Lieber’s general opinion was widely shared. ‘To solve the world’s problems’, another logic book remarked ‘we must have brave new thinkers for our world’ (Keyes, p. 236). That book goes on, with illustrations, to conjure a catastrophic atomic future that will surely arrive if logic is not studied assiduously. A great many more sources could be cited but we add only two. Neurath, always given to programmatic statements, noted that, of course, not everyone could be a practising scientist,

But it is intensely desirable and under certain conditions practicable that *all* human beings become scientific in their attitudes: genuinely intelligent in their ways of thinking and acting. (Neurath, p. 38)

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Finally, Charles Morris said

It is because of [the] relation of scientific activity to other activities that the scientific habit of mind, and scientific results are of such potential promise in society at large and education in particular. (Morris, p. 74)

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Morris then pays tribute to Dewey, who had ‘devoted his life to the formulation and assessment of the social, cultural and educational implications of the scientific habit of mind’ (p. 75). Dewey’s intentions had been broader, not specifically wedded to the logic of *Principia*, but he had prepared the ground for the ready acceptance of the message of the many immigrants. Tyron Edwards remarked, in the spirit of Dewey,

The great end of education is to discipline rather than furnish the mind; to train it to the use of its own powers, rather than fill it with the accumulation of others. (Keyes, p. 230)

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This emphasis on methodology rather than the mastery of literary or philosophical canons advanced the fortune of formal logic teaching, which soon grew to monumental proportions. Lieber thought that the development of atomic weaponry lent new urgency to this message. The *Bulletin of the Atomic Scientists* had begun to appear, with its ominous clock showing just minutes to doomsday. On the opposing side we find various interests pushing for atomic armament, deterrence; there were nationalist groups, even religious fanatics welcoming an imminent Armageddon. The division was obvious: science, sanity and logic in one corner, ANTI-SAM-ITISM in the other.

She held that intersubjective, scientific cognition can and must replace subjective perception. We must come to think of objects in the world not just from our viewpoint, and as they appear to our senses, but 'objectively', that is, in terms of scientific realism. Social reform must rest on a scientific culture at whose foundation lie the tough and rigorous canons of mathematical logic, paradigmatically formulated in *Principia Mathematica*. Logical shrewdness, moderation, and a suspicious and sceptical mind-set are not in the end enough. The next step in her argument gives pause, however: as scientific realism replaces subjective perception, moral subjectivism and individualism will give way to an objective, communitarian appreciation of values, goals and needs. No real argument is offered why this transformation of values would occur. It was thought to attend scientific realism as the shadow follows the substance. This glowing optimism was a shared faith of the neo-positivist movement.

Logic teaching must be got into the schools as soon as possible, preferably through a massive *programme*. There is a race on. These days there is a great deal of suspicion of such broadly based initiatives. But it was not so outlandish, at that time, to suppose that a benign government could bring forth common and shared educational goals. 'In the experience of that generation', notes Theodor Roszak, 'government meant the New Deal that had brought the Nation out of the Depression. That same government had led the Nation to victory in World War II... People trusted the government to solve problems and provide leadership' (Roszak, p. 65). To have more, and more pervasive, government did not seem irrational; indeed, not only the authorities, but the broad citizenry regarded even the few anti-government protests with alarm. Lieber's move from scientific objectivism to moral altruism is, unfortunately, disproved in her own book. In uncharacteristic sloppiness she cites a book she had not carefully read, noting that the strict logical approach had now been applied to the study of human relations and decision making in von Neumann and Morgenstern's *Theory of Games and Economic Behaviour*. This calls for a brief digression.

Game Theory, Lieber thinks, will 'PUT THE WONDERFUL MATHEMATICAL SYMBOLISM to NEW and IMPORTANT USES' (Lieber, p. 83). Yet Game Theory would be closely associated with both individualistic rationality and nuclear armament, both of which Lieber hoped SAM would defeat. Game Theory treats of 'conflict among rational but distrusting beings' (v. Neumann, p. 39) and began with two-person, zero-sum games in which one participant could win only if another lost. This formed the foundation for the individuality implicit in game theory strategy and the minimax theorem, which would find a rational solution to games based on self-interest and mistrust (v. Neumann, p. 97). As the theory was extended to non-zero-sum games, co-operation began to find some foothold—a promising development since non-zero-sum games seemed much more applicable to real life.

At this point Merrill Flood and Melvin Dresher discovered the *Prisoner's Dilemma*. This non-zero-sum game cripples Lieber's theory of co-operation and collectivism through rationality, as the possibility of co-operation makes a rational decision in the Prisoner's

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Dilemma much more difficult than in the zero-sum game. Rationality and logic, irrationally enough, leads players of this game to receive less than they would have had they co-operated. Defection is the only rational solution. It was in this reasoning that the Cold War that Lieber condemned so strongly found a logical basis.

Game theory was seen as 'propagat[ing]...long term changes...in a paranoid and odious direction. [This is said in reference] not only [to] the propagation of the premises of distrust which are built into the von Neumann model *ex hypothesi*, but also [to] the more abstract premise that human nature is unchangeable' (from a 1952 letter by anthropologist Gregory Bateson [Heims, p. 307]). Lieber would have been better off omitting reference to von Neumann, a man who was known as early as 1950 to support preventive war. This man, who Lieber thought was forging new ground for logic and rational thinking, is quoted as saying 'If you say let's bomb them tomorrow, I say why not today? If you say today at five o'clock, I say why not one o'clock?' (Heims, p. 247)

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I don't want to go as far as to claim that game theory contributed to the decline of faith in formal logic. But it certainly destroyed the faith that formal logic and scientific rationality create communitarian values.

CONCLUSION

Formal logic instruction is no longer thought a pre-eminent instrument of social improvement, partly because the united front of classical logic has split up into a plethora of 'deviant' logics, and surely also because claims that political maturity, or even communitarian virtue, are nourished by the study of formal logic are vacuous. Masters of the subject are not obviously more politically aware or mature than others; Frege is a notorious example, so is von Neumann, and I could add others to that list. Wholesome political and social effects are more likely brought on by informal logic instruction properly conceived.

And also, the current climate of political opinion does not favour the ideals Neurath and others dreamt of: SHARING, WORLD GOVERNMENT, INTERNATIONAL POLICING (Lieber's words). Teachers of logic and critical thinking now set themselves more modest goals. No one denies that logic, properly taught and not stuck on formalism, does indeed make people more cautious in their reasoning, less gullible, more coherent, less moved by unreflected opinion. This is a good and socially valuable thing and justifies its broad teaching. While reason itself once seemed to bring altruism in its train, the rhetoric of rationality has now been captured by the political right. The charming, if overblown, expectations of *Mits, Wits and Logic* are gone. Applied logic has become more critical of itself and is now meant to provide a tool kit mostly for coping in the ongoing struggle of the individual against deception and manipulative political and commercial propaganda. The public activity of the formal logician no longer includes social reform as an integral part: no one now thinks that logic as such brings forth ideology, and many would be alarmed at the thought that it might.

Note: We have been critical of Lillian Lieber's message, but have the highest respect for her person and achievements. She died in obscurity in 1986 at the age of 100. In the 1930's and 40's she chaired the mathematics department of Long Island University, in those days an extraordinary achievement for a woman, founded the Galois Institute in Brooklyn (it closed in the 60's) and became well known for her books and heroic efforts to bring science and mathematics to the common people. We print her picture (1910) and list her publications, many



illustrated by her husband Hugh Gray Lieber: *Non-euclidean Geometry*, Academy Press 1931, *Galois and the Theory of Groups*, Lancaster, PA 1932, *The Einstein Theory of Relativity*, Lancaster, PA 1936, *The Education of TC Mits*, Galois Institute, Brooklyn 1942, *Modern Mathematics for TC Mits*, *The Celebrated Man In The Street*, Allen&Unwin, London 1946, *Take a Number: Mathematics for the Two Billion*, Lancaster, PA 1946, *Mits, Wits and Logic*, W.W. Norton, NY 1947, *The Einstein Theory of Relativity*, D. Dobson, London 1936, *Infinity*, Rinehart, NY 1953, *Mits, Wits, and Logic*, Galois Institute, Brooklyn 1954, *Lattice Theory; the Atomic Age in Mathematics*, Galois Institute 1959, *Human values and science, art and mathematics* Norton, NY 1961, *Mathematics: First S-t-e-p-s*. F. Watts, NY 1963.

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